A REVIEW OF THE MENDELIAN PRINCIPLES OF HEREDITY.

Special Correspondence.

A solution of the laws of heredity will undoubtedly work a greater change in man's knowledge of plant and animal life, and his power over nature, than any other advance in natural knowledge.

There isn't the slightest doubt but that these laws can be determined. The amount of labor put on this subject is comparatively insignificant compared with that put on other branches of science.

It seems strange that while our knowledge in physiology has increased so much, our knowledge of heredity has increased but little, though it constitutes the basis of all physiological science. This lack of knowledge is not due so much to the special difficulty of such inquries as to general neglect of the subject.

The very central problem of natural history is admitted by nearly all people and no one has better opportunities of pursuing such work than horticulturists and stockbreeders. They are daily witnesses of the phenomena of heredity and their success depends largely on a knowledge of its laws.

Many neglect this line of study because they suppose it requires a lifetime to obtain any results. Although long periods of time are necessary for an adequate study of the complex phenomena of inheritance, yet in our present state of ignorance in this line of work, observations carefully planned and carried out for even a few years may produce results of great value. In fact, it seems, the most appreciable and definite additions to our knowledge in this line have been thus obtained.

In order for a systematic study of heredity we must first find how far man has got toward an exact knowledge of heredity, then we must decide on the line of work that is best adapted to our conveniences. We want to know the physical basis, the inward and essential process by which the likeness of the parent is transmitted to the offspring. We only know one of the many factors which determines the degree in which a given character shall be present in a given individual and that is, the degree to which that character was present in the parents.

We are as far as ever from knowing why some characters are transmitted, while others are not; nor can we tell which parent will transmit characters to the offspring and which will not. Very few experiments have been made along this line, the most notable being those of Galton on human stature and on the transmission of color in Basset hounds.

From these experiments he has shown that the expectation of inheritance is such that a simple arithmetical series is followed, namely, that of the whole heritage of the offspring the two parents on the average contribute half, the four grandparents, one fourth, the eight great-grandparents, one eighth and so forth. However, there are many exceptions to Galton's law and further work is needed both with plants and animals to eliminate the fallacies and make the principle of universal application so it can be applied to the complex cases of inheritance of varietal character. Nevertheless Galton's work has stood almost alone until recently. In 1900 Prof. de Vries published a short account of a series of experiments he had carried on for several years. The work relates to a course of heredity in cases where definite varieties differing from each other in one definite character are crossed together. The cases are all of discontinuous variation; that is, cases in which actual intermediates between the parent forms are not usually produced on crossing. It was shown that the posterity of these crossbreds or hybrids, self-fertilized or bred with each other, break up into the original parental forms according to a fixed numerical rule. Prof. de Vries begins by referring to a remarkable memoir by Gregor Mendel, giving Mendel's results of an extended experiment in crossing varieties of Pisum sativum. Mendel's work is at present causing considerable comment among natural scientists. It seems strange that a work of such great importance should so long have escaped recognition and become current in the world of science.

Mendel was born at Heinzendorf bei Odrau in Austrian Silesia, July 22, 1822. He became a teacher in the Realschule at Brunn and it was in the garden of his cloister that his experiments were carried out. His valuable contribution was given to the Brunn society in 1865, three years previous to the appearance of Darwin's noted "Animal and Plants." Had Mendel's work come into the hands of Darwin, it is quite probable that the history of the development of evolutionary philosophy would have been very different from that which we have witnessed.

That Mendel's work was not brought to notice before 1897, appearing in a time when several naturalists of first rank, were occupied with these problems and the more so as the Brunn society exchanged its publications with most of the academies of Europe, seems strange.

For his experiment with Pisum he selected seven pairs of characters as follows:

(1) Shape (round, angular or wrinkled) of ripe seed.
(2) Color of "endosperm."
(3) Color of seed skin.
(4) Shape of seed pod.
(5) Color of unripe pod.
(6) Mature of inflorescense.
(7) Length of stem.

Many crosses were made between peas differing in one of each of these pairs of characters. It was found in each case the offspring of the cross exhibited the characteristics of one of the parents in almost undiminished intensity, and intermediates which couldn't be referred to one of the parental forms were not found.

Those possessing the prevailing characters, Mendel calls dominents, and the others recessives. In the first generation from the parents he found the dominents were to the recessives as 3 to 1. These plans were self-fertilized and in the second generation it was found the recessives remained fixed, but the dominents broke up into two classes, one which gave pure dominents thereafter and the other which gave the mixed or crossbreds again. In the next generation these mixed or crossbreds broke up into 25 per cent pure dominents, 50 per cent crossbreds and 25 per cent pure recessives. So he obtained the rataio 1 D: 2 DR: 1 R.

Each generation thereafter broke up in the same proportion. The dominents and recessives are the parental forms and each generation a certain proportion would revert to the original parental forms. Mendel admits that there are cases wherein the crossbreds maintain themselves pure and don't break up. His work was just with peas and Hieracium and it remains for someone else to determine how many other species of plants follow this rule. Even if others are found to not follow the same rule it seems quite probable, having Mendel's work as a basis, many promising results may be obtained.

"Most people in their experiments in crossing plants and animals have failed to take careful notice of three very essential factors," says Prof. Bateson. "Their experiments were not carried on with sufficient accuracy to determine the number of forms under which the offspring of hybrids appear, or to arrange these forms with certainty according to their separate generations and they failed to definitely ascertain their statistical relations."

Mendel claimed that "if two organisms having exactly similar germ cells, unite, the offspring will be uniform." In practise this is seen in pure breeding. But if two dissimilar germ cells unite, the offspring may resemble either parent or it may be something entirely different.

In a simple case he says, "if an individual possessing any character in intensity A unite in fertilization with another individual possessing the same characters in intensity (a) what will be the character of the offspring? Up to Mendel no one would attempt an answer in any way except by reference to the intensity of the characters in the progeny and principally in the parents." They claim that the hybrid (Aa) will be influenced by a long line of ancestry; but Mendel claimed the gametes are pure and the gametes in the resulting offspring will be pure and there will be no blend between any two cells. The cells are pure as are chlorine and sodium, but the combination of the two may bring a new form entirely as the combination of chlorine and sodium produces salt.

Mendel claimed "Na Cl is a body not half way between Na and Cl, or such that its properties can be predicted from or easily stated in terms of theirs." Example: if a tall pea A be crossed with a dwarf a the offspring may be a plant taller than the pure tall variey A.

Mendel found that in crossing two plants with two dissimilar characters A and B in the first offspring he found 75 per cent which resembled one parent exclusively and 25 per cent which resembled the other. The 75 per cent recessives. In the first generation from planting these crossbreds the 25 produced offspring like themselves and each succeeding generation they remained constant. But the offspring of the 75 broke up and gave 25 pure dominents and 50 crossbreds. The dominents and recessives thereafter remained constant while the crossbreds in each succeeding generation broke up into 25 dominents, 50 crossbreds and 25 recessives, thus giving the ratio 1 AA: 2 AB: 1 BB.

Mendel says "the dominents and recessives are the parental forms," but he makes no attempt to determine the character of the hybrid, save that they may resemble one parent almost exclusively, they may represent some condition intermediate, or they may possess a form entirely different from either parent as "the wild grey mouse" is from the union of an Albino tame mouse and a piebald Japanese mouse.

From these Prof. Bateson presents us with some new conceptions namely: (a) The purity of the gametes in regard to certain characters. (b) The distinction of all zygotes as to whether they are or are not formed by the union of like or unlike gametes. In the former case apart from variation they breed true when mated with their like, in the latter case their offspring collectively will be heterogenous. (c) If a zygote be formed by the union of dissimilar gametes, we may have dominents and recessives, intermediates, or forms entirely different from either parent, often reversionary. (d) Unit characters when once arisen by variation are alternate to each other in the constitution of their gametes. (A character that is capable of being replaced by its contrary is called a unit character). (e) A compound character borne by one gamete is transmitted as a single character so long as it is fertilized with like gametes, but if fertilized with unlike gametes the compound alleiomorph is broken up into its integral parts. (f) Analytical variation. (g) Synthetical variation occurs not by separating preexisting characters; but by the addition of new characters.

It certainly requires much courage to carry on a labor so exacting but by careful attention, and work, results can be obtained that will well pay for the energy put forth.

If it is desired to carry on experiments in this line, in order to obtain the best results, one must carry on as many experiments, as there are constantly differentiating characters in the experimental plants. The seven characters mentioned in this article may be considered with peas. Of course it necessitates great care if more than one pair of characters is considered at once. In crossing plants we obtain almost an innumerable quantity of new forms, but all are not desirous and the great difficulty lies in establishing the desirable qualities so they will thereafter remain permanent and not revert.

So far as experience goes, we find in every case confirmed that constant progeny can only be formed when egg cells and fertilizing pollen are of like character.

Since the various constant forms are produced in one plant, or even in one flower of a plant, it seems perfectly reasonable that in the ovaries of the hybrids there are formed as many sorts of egg cells, and in the anthers as many pollen cells, as there are possible combination forms and that these egg and pollen cells agree in their internal structure with those of the separate forms. So if two plants differ in two pairs of characteristics we may have from uniting the two as many different forms as there are combinations between these two characters. If we have two pairs of differentiating characters we get 16 individuals, nine of which have different forms. This law of combination which develops the forms of hybrids is based on the principle that the hybrid produces egg cells and pollen cells which in equal numbers represent all the constant forms which result from the combination of characters brought together in fertilization.

According to the pure germ cell theory, if a pollen cell happens to unite with a similar egg cell the resulting offspring will resemble one parent or the other according to which is dominent or prepotent; but if it meet a dissimilar egg cell the resulting offspring may resemble one parent or the other or neither. Where the cells are similar there is no compromise between the cells in order to form the hybrid offspring, but for two dissimilar cells to unite there must be a compromise; but the conflicting elements are only temporary and will not endure throughout the life of the hybrid plant.

If it be desirable to transform a species A into a species B both must be united in fertilization and then the resulting hybrids must be fertilized with B for three generations or more and finally the form A will be changed to the form B. In order to fertilize hybrids to fertilize it is necessary to choose the most promising plants. Before the change, however, little is known of it by lack of investigations, but recently many have become interested in the science and likely in 10 years hence we shall look back on our present captivity. The praises for Mundel's work are loud and numerous. One critic says, "The thanks of the world are due to him (Mendel) for the masterly way in which he has proved the existence of a defined law where hitherto all seemed chaos." His translator writes thus: "Soon every science that deals with plants and animals will be teeming with discovery, made possible by Mendel's work." The breeder, whether of plants or animals, no longer trudging in the old paths of tradition, will be second only to the chemist in research and foresight. Each conception of life in which heredity bears a part—and which of them is exempt?—must change before the coming rush of facts.

J. W. NELSON,
Bureau of Soils, Washington, D. C.

OSTRICH FEATHERS VERY MUCH WORN.

Ostrich is still immensely worn and continues to rival flowers in the estimation of Parisians, though the latter are a more seasonable decoration and exhibited in greater variety. There is also a steady deamnd for couteaux, both small and large. Paradise is being supplanted by the sparsely barbed underfeathers of the ostrich, generally deemed of little or no value. Two or three such feathers totally devoid of curl are fastened together by their middle underneath the brim of the hats. They have nothing to recommend them but their novelty and are distinctly inferior to all other sorts of aigrette.

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OREGON SHORT LINE Time Table

In Effect Feb. 1, 1903.

ARRIVE.

From Ogden, Portland, Butte, San Francisco and Omaha 9:30 a.m.
From Ogden and intermediate points 9:10 a.m.
From Calientes, Milford, Nephi, Provo, and intermediate points 9:35 a.m.
From Ogden, Chicago, St. Louis, Omaha, Denver and San Francisco 12:31 p.m.
From Ogden, Chicago, St. Louis, Kansas City, Omaha, Denver and San Francisco 4:05 p.m.
From Garfield Beach, Tooele and Terminus 4:55 p.m.
From Tintic, Mercur, Nephi, Provo, and intermediate points 5:35 p.m.
From Ogden, Cache Valley, Butte, Portland, San Francisco 7:55 p.m.

DEPART.

For Ogden, Omaha, Chicago, Denver, Kansas City and St. Louis 7:00 a.m.
For Tintic, Mercur, Provo, Nephi and Manti 7:20 a.m.
For Garfield Beach, Tooele and Terminus 7:45 a.m.
For Ogden, Portland, Butte, San Francisco and intermediate points 9:45 a.m.
For Ogden, Omaha, Chicago, Denver, Kansas City, St. Louis and San Francisco 12:50 p.m.
For Ogden, Cache Valley, St. Louis and Chicago 5:45 p.m.
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For Ogden, Cache Valley, Butte, Helena, Portland, San Francisco and intermediate points 12:30 a.m.

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No. 4—For Provo, Grand Junction and points east 8:20 p.m.
No. 10—For Bingham, Lehi, Provo, Manti, Marysvale and intermediate points 8:00 a.m.
No. 8—For Provo, Payson, Eureka and intermediate points 5:00 p.m.
No. 3—For Ogden and the west 11:45 p.m.
No. 11—For Ogden and all intermediate points 6:10 p.m.
No. 1—For Ogden and the west 11:30 p.m.
No. 5—For Ogden and the west 11:55 p.m.
No. 9—For Ogden and the west 3:05 p.m.
No. 102—For Park City and intermediate points 8:00 a.m.

ARRIVE SALT LAKE CITY.

No. 10—From Ogden and all intermediate points 7:50 a.m.
No. 12—From Ogden and all intermediate points 9:05 a.m.
No. 6—From Provo, Grand Junction and the east 8:10 a.m.
No. 1—From Provo, Grand Junction and the east 11:45 p.m.
No. 3—From Provo, Grand Junction and the east 11:45 p.m.
No. 9—From Provo, Bingham, Heber, Marysvale and intermediate points 6:00 p.m.
No. 6—From Ogden and the west 8:15 a.m.
No. 2—From Ogden and the west 2:55 p.m.
No. 4—From Ogden and the west 7:55 p.m.
No. 7—From Eureka, Payson, Provo and intermediate points 10:00 a.m.
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